The Examiner rejects claims 1, 12-14, and 21 under 35 U.S.C. §103(a) as being unpatentable over Verhoeckx et al. (hereinafter Verhoeckx) (U.S. Patent No. 4,005,265). Claims 1-5, 12-15, and 21-25, stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tompkins et al. (hereinafter Tompkins) (U.S. Patent No. 4,847,829) in view of Verhoeckx. Claims 7, 17, and 27 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tompkins and Verhoeckx and further in view of Ramanathan et. al. (hereinafter Ramanathan). Claims 8, 18, and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tompkins, Verhoeckx, and Ramanathan, and further in view of Rangan et al. Claims 9-11, 19-20, and 29-31 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tompkins, Verhoeckx, and Ramanathan and further in view of Stefik et al.

Applicant respectfully traverses these rejections, and requests reconsideration and allowance of the pending claims in view of the following arguments.

The present invention relates to a computer–based video conferencing system and method that can reproduce color video images at TV quality. Independent claims 1, 12, and 21 specifically recite the control of reproduction of color video images, at TV quality, by utilizing an Unshielded Twisted Pair (UTP) communication path. Applicant submits that the cited reference, either alone or in combination with the other art of record, does not teach or suggest these features and, therefore, that the claims of the present application are patentable.

In the Office Action, the Examiner asserts that Verhoeckx, at col. 3, line 9; col. 7, line 32, teaches color video images that are reproduced at TV quality.

D

Verhoeckx appears to mention the transmission of color television signals as part of an example of the disclosed synchronizing system. However, contrary to the Examiner's assertion, Verhoeckx does not teach the reproducing of color video, and especially does not teach the reproducing of color video at TV quality. Verhoeckx describes a system that transmits picture information at every second or third line flyback period of a video signal transmission, but does not describe TV quality video (col. 2, lines 65-68). Verhoeckx then notes that it is possible to transmit other signals, such as "signaling, test signals, or a color burst," in the unused flyback periods (col. 3, lines 4-8). Verhoeckx is merely describing an aspect of its system which, arguably, allows fewer transmissions of picture information during the flyback period of a color signal transmission. While Verhoeckx is attempting to teach <u>when</u> various forms of synchronizing information may be transmitted during the flyback period, it clearly does not teach the transmission of a color video image. For example, the Verhoeckx system is designed to operate at a maximum video frequency of 1 MHz, and cannot therefore teach color video since the color video systems used at the time of the Verhoeckx invention required at least a 3.5 MHz bandwidth for transmission. (See attached copy from the "*Television Engineering Handbook*," McGraw-Hill, 1986). Accordingly, Verhoeckx does not teach the transmission of color video signals, as claimed in the present application.

Even assuming *arguendo* that Verhoeckx discloses the transmission of a video signal, it does not teach the transmission of a <u>color</u> video signal at <u>TV quality</u> (i.e., 25 Hz). Although Verhoeckx describes a picture frequency at 25 Hz, it does not describe the picture resolution that is being transmitted at that frequency (col. 7, line 32). For the Examiner to infer a particular resolution from this sketchy description in Verhoeckx is improper hindsight reconstruction, derived solely

from the teachings of the present application. In fact, Verhoeckx is completely silent as to resolution and picture color that is being sent at this frequency. Accordingly, even if Verhoeckx does transmit a video signal at TV quality (25 Hz), it clearly does not teach the transmission of a color video signal at that frequency.

Applicant further submits that the claims of the present application, which specifically recite using UTP wire for the transmission of TV quality color video, are not taught or suggested by Verhoeckx. In fact, Verhoeckx is incapable of teaching the transmission of TV quality color video signals over UTP. The Verhoeckx system is based on existing telephone wires (i.e., UTP) and is therefore limited, by its own disclosure, to a bandwidth of 1 MHz (col. 1, lines 4-6). It was well known in the art at the time of the Verhoeckx system, and more importantly, at the time of the present invention, that a 1 MHz bandwidth could not support reproduction of color video at TV quality. Indeed, all of the major color video systems used in the world today, (i.e., NTSC, PAL, and SECAM), and at the time of the present invention, require bandwidths of at least 3.5 MHz to operate. (See attached copy from the "*Television Engineering Handbook*," McGraw-Hill, 1986). Accordingly, Verhoeckx cannot possibly teach or suggest the transmission of color video at TV quality (i.e., NTSC, PAL, or SECAM) since that would require the transmission of a 3.5 MHz signal over a UTP transmission system known in the art at the time of the invention as having only 1 MHz bandwidth (i.e., UTP), which is not possible. The non-enabling nature of Verhoeckx is yet a further reason why claims 1, 12, and 21 are patentable.

The Examiner next rejects claims 1-5, 12-15, and 21-25 under 35 U.S.C. §103(a) as being unpatentable over Tompkins in view of Verhoeckx.

Apparently, at least in part as an alternative to reliance solely on Verhoeckx, the Examiner asserts that Tompkins teaches each of the claim limitations, except for the use of UTP for the transmission of the video. The Examiner attempts to remedy this deficiency of Tompkins by relying upon Verhoeckx to teach the UTP limitation.

Although the Examiner has combined Tompkins and Verhoeckx, Applicant asserts that no suggestion exists to combine these references. Moreover, the Tompkins reference actually teaches away from what is disclosed in Verhoeckx.

Applicant submits that "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivations to do so either in the references themselves or in the knowledge generally available to one of ordinary skill in the art." *See* M.P.E.P. § 2143.01 (*citing In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988)). Also, "if [the] proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *See* M.P.E.P. § 2143.01 (*citing In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984)). Furthermore, "it is improper to combine references where the references teach away from their combination." *See* M.P.E.P. § 2145 (*citing In re Grasselli*, 713 F.2d 731, 743, 218 U.S.P.Q. 769, 779 (Fed. Cir. 1983)).

Tompkins is directed to a video conferencing network that relies upon a coaxial cable link to connect each of the video terminals (col. 3, lines 10-11). The coaxial cable utilized by Tompkins is necessary to handle the high bandwidth required by the system, as seen by the Tompkins system

occupying two separate portions of the frequency spectrum, around 70 MHz and 170 MHz, for audio, video and data transmission (col. 14, lines 4-10; FIG. 5).

On the other hand, as described above, Verhoeckx describes a system which utilizes UTP (having only a 1 MHz bandwidth) for signal transmission. Should one of ordinary skill in the art have combined the Tompkins video conferencing system, with the UTP wiring of Verhoeckx, the resulting system would have comprised a system that would attempt to transmit signals, at around 70 MHz and 170 MHz, on a 1 MHz (UTP) wire. Clearly, this is not possible, and therefore such a combination would render Tompkins inoperable. Since Tompkins, if modified as the Examiner suggests, would be rendered unsatisfactory for video, audio, and data transmission, it cannot possibly have been obvious to adopt the Examiner's proposed modification of using UTP disclosed by Verhoeckx.

Not only does Tompkins not suggest the use of UTP in its system; Tompkins actually teaches away from using UTP. Tompkins states that in order to provide full motion color video, a greater bandwidth is required than for the transmission of facsimile data (col. 1, lines 44-47). Tompkins goes on to discuss that the most effective full motion video conferencing systems transmit over a high bandwidth T1 telephone line, or on a 56 kbps network by utilizing compression algorithms (col. 1, line 67 to col. 2, line 14). However, Tompkins notes that the 56 kbps systems lose resolution when overwhelmed by too much motion (col. 2, lines 32-33).

After describing the above disadvantages for full motion video conferencing, (i.e., high bandwidth T1 lines and degraded resolution with increased motion), Tompkins presents a system that relies upon coaxial cable in an attempt to obviate these problems. In other words, Tompkins

teaches away from using existing telephone wires (UTP) by specifically noting the disadvantages of UTP and utilizing coaxial cable in light of these disadvantages.

Additional evidence of Tompkins teaching away from using UTP wiring can be found in the prosecution history of that patent. The Tompkins file history describes how UTP wiring is incapable of meeting the requirements of their system, and how the Tompkins system requires coaxial cable. As such, Applicant respectfully invites the Examiner to view the prosecution history of Tompkins. Applicant therefore asserts that Tompkins teaches away from using UTP, and so teaches away from relying on Verhoeckx as a modifying teaching. Therefore, Tompkins, whether combined with or modified by Verhoeckx, does not teach or render obvious the Applicant's invention, as claimed in independent claims 1, 12 and 21. Thus, these independent claims, and their dependencies, are patentable.

In summary, Applicant has shown that Verhoeckx does not teach several features of the claimed invention. Specifically, Applicant demonstrated that Verhoeckx does not teach the transmission of TV quality color video on UTP. Applicant also has shown that modifying the Tompkins system, with the Verhoeckx UTP teachings, would result in a system that would be incapable of accomplishing the invention's intended purpose, and therefore lacks any suggestion that they can be combined. Furthermore, Applicant has shown that Tompkins teaches away from using UTP in a video conference system, further supporting Applicant's assertion that the combination of these references is improper. Accordingly, Applicant asserts that Verhoeckx and Tompkins, taken either alone or in combination, do not teach or render obvious the present invention as recited in independent claims 1, 12, and 21, and therefore, these claims are patentable.

D

OIPE
NOV 2 2 2000
PATENT & TRADEMARK OFFICE

Neither Ramanathan, nor Rangan, nor Stefik remedies any of the identified deficiencies of Tompkins or Verhoeckx. Therefore, pursuant to the foregoing discussion, Applicant submits that claims 1-5, 7-15, 17-25, and 27-31 are patentable.

The Examiner's rejections having been overcome, Applicant submits that the subject application is in condition for allowance. The Examiner is respectfully requested to contact the undersigned at the telephone number listed below to discuss other changes deemed necessary. Applicant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,

Jeffrey Lotspeich #45,737 for

Frank L. Bernstein
Registration No. 31,484

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
Tel: (650) 325-5800

23493
PATENT TRADEMARK OFFICE

Date: 11/17/00

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

Assistant Commissioner for Patents
Washington, D.C. 20231

Date: 11-17-00

Signed: [signature]

RECEIVED
NOV 2 7 2000
Technology Center 2100

VIDEOMATIC SWITCHING: SYSTEMS AND SERVICES

C. Crawford, F. Milone, D. Zoppellaro
Italtel SIT - Milan, Italy

Abstract

This paper gives an overview of the trends in Videomatic services and systems now coming into being thanks to the advent of ISDN and the promise of broadband ISDN. Service aspects are discussed and the LVX (Local Video Exchange) system, an integrated video-voice-data local area network, is described from implementation and technical standpoints.

1. Introduction

The Eighties have seen technological advancements in communications which have permitted planners to speculate about a new gamma of videomatic services, but without the accompanying economies of scale, that is to say low costs, which would permit manufacturers to experiment services free of risk. Video-coding, high-bandwidth optical transmission, multi-service workstations, and broadband switching elements are the cornerstones of this new field.

While the industry waits for international standards which won't be finalized until the early 1990's, Italtel has decided to gamble that a small market will open in the meantime and as a consequence has begun technology and service trials with existing, albeit not optimized, building blocks. At this stage, judging customer's reactions and creating an awareness in the telecomunication culture are probably more important than tecnical innovations. Italtel has endeavored to choose a flexible architecture that can be mutated, functional component by functional component, to adapt to evolving standards in the coming decade, empasizing and trying to better identify services, the majority of which are rather technologically independent.

2. The Telecom Video Scenario

Most large telecom manufacturers and operating companies have begun to experiment with new video services and to design and build prototype equipment to implement these services. In Europe the tendency has been to focus on videoconferencing centers for corporate clientele by using 2 Mbit/s leased lines between rooms to form small dedicated networks. Japanese manufacturers have focused on the mass market as well and have produced videophones employing small flat panel displays and destined for a single subscriber in a large network. In the U.S.A., several firms produce small 'closed' videotelephone networks which provide desk-to-desk service with integrated data services, but with limited public network interfacing.

Two factors are largely responsible for stemming the spread of video services in the public network: the high price of low bit-rate video codecs and the lack of a capillary switched data network of speeds 64 kbit/s and greater. Italtel sees the most logical niche for videomatic networks in the 64 kbit/s switched network (eventually ISDN) aimed at business users with terminal equipment capable of providing tele-work sessions, that is: video data and voice for local and long distance connections.

3. An Overview of Videomatic Services

Table 1 outlines many of the video oriented services being discussed today. The CCITT Study Group XVIII has taken a special interest in the topic and for services such as videotelephony, service prose descriptions and signaling strategies have already been drafted.

As the matrix makes evident, the LVX aims to satisfy corporate users who typically have several office centers nationally with inter/intra node video-voice-data connections. Rather than specialized terminal equipment for one aspect or another, the LVX approach has been to provide a general purpose terminal capable of accessing, without changing hardware, whatever subset of services the subscriber desires.

3.1 Multipoint Videoconference Services

One service aspect still under study is the best way to operate multi-point videoconference sessions. Three methods have gained some currency amomg project planners, the most economic of which is the "directed broadcast" method in which all conference signals travel upstream to the CO where, by way of signaling based on a selection algorithm (i.e. audio thresholds, user choice, etc..) a unique inbound signal is chosen for rebroadcast to every participant. This method is attractive because it requires no special video-processing gear in the CO (not the case for the audio though).

Fully meshed systems use more of a brute-force approach, requiring that every participant have a video-audio-data connection with every other participant. Once again, no special gear is required in the CO but the number of links and the quantity of equipment needed at the customer site is onerous.

The third and most favored method uses conference mixing units located in the CO and only one full duplex link between the CO and every participant. All inbound signals are directed to the conference management unit where the images may be combined on a split screen, audio is mixed and delays are added where needed (congruent with video codec delays). This newly composed signal is then transmitted outbound to all participants.

In this phase of the LVX development , the 'directed broadcast' method seems the most

Reproduced with permission of copyright owner. Further reproduction prohibited.

appealing for the LVX business user because of its ecomony and because of the difficulties of tramsitting intact, complex images over 64 kbit/s lines.

4. Functional Blocks of the LVX

4.1 Dimensions

The LVX is designed to function in a campus area with a diameter of less than 8 Km. Provisions have been made to network more than one LVX together in a wide area network. Each node supports nominally 16 users and may grow up to 200 users. Intranode video switching and transmission takes place in the analog domain while signals that enter the public network are digitized.

Figure 1 illustrates the major bulding blocks of the system which can be roughly divided into three zones: the command and control center, henceforth called the central office or CO, the transmission system, and the user workstation. The CO can be conveniently broken down further into the command computer and three switching fabrics: voice, data, and video.

4.2 National Networks

One of the ultimate goals of the project is to link several nodes together in a national network. Italtel is participating in two initiatives to realize such a network; one ia a three node network connecting universities in Sicily, and the other, pictured in figure 2 will link members of the STET holding group in Rome, Milan, and Turin.

5. Services of the LVX

5.1 Video Services

The LVX provides integrated voice/video/data services. Each user can be connected to another user for a point to point video call after having previously established a voice link using the customer's existing telephone network be it a PBX or the public network. In large configurations the three-stage switch design will introduce a low blocking probability for this type of connection.

Each user can access up to 10 broadcast channels from local sources such VCRs. antennae, or, eventually, interactive, optical disk based, image data bases.

5.2 Data Services

Every workstation comprises an MS-DOS based microcomputer equiped with a serial port and a modem. Workstations are programmed with a file transfer protocol, a subset of which is an electronic mail service. A modified version of the X.400 messaging protocol will be implemented which allows users to access an MTA (Message Transfer Agent) using the P7 protocols for the DIALCOM systems installed in Europe. For terminal to host connections, every user is fitted with a DEC VT100 terminal emulator.

In addition to these network features and all local MS-DOS applications, a workstation can interface, by means of its modem, with an X.28 port of an X.25 packet network and with popular videotex protocols such as Videotel and Prestel. The telephone handset interfaces to the PC for automatic dialing and modem enabling.

Italtel considers these services to be value-added and as a consequence should interfere as little as possible with the extant phone network. The voice services are thus those already available on the user's network; no modifications or interfaces to the customers PBX need be effected.

5.3 Gateways

The LVX is furnished with a series of gateways to carry the video/voice/ data signals beyond the campus boudaries. Multiple LVX systems can be connected on the 64 Kb/s switched network now available in Italy, the RFD, thanks to new video codecs which compress the PAL signal to 48-224 Kb/s. Point to point video connections can be implemented with non-homogeneous systems but the data services will be somewhat impaired. Using 2Mbit/s circuits it will be possible to interface the LVX node to public videoconference centers that use the COST-211 codecs and eventually to internetwork with the 2 Mb/s network dedicated to this service. Various gateway services, including packet (X.25) and leased circuits, are feasible.

6. Technical Foundations

6.1 Control Element

The brain of the system is the Italtel Packet Handling Processor (PHP) developed at the CSELT laboratories for the Italtel UT line of public switching equipment. The PHP uses a Z8000 CPU in a fault tolerant architecture and uses a multi-tasking real-time operating system developed at Italtel for communications applications. The PHP is aided in I/O tasks by a Front-End Processor (FEP) which offloads gateway management. The FEP is tasked with multiplexing videotelephony signaling from all the users to and from the command PHP via 8 port RS-232 user boards and performing dialing and access functions towards the 64 Kb/s switched network.

Currently, only the command processor and the wideband matrix are fault-tolerant while the peripheral processing equipment is not. Taken as an evolved form of PBX, this stands well with current practice, which typically does not stipulate fault-tolerance in private systems (except in military applications) but if considered as a value added service to a public CO fault-tolerance must be provided for at some time.

6.2 Switching Elements

6.2.1 Digital/Analog Hybrids

There is an overwhelming drive today to abandon analog transmission and adopt digital coding for all manner of signals. The political and industrial sponsors of this credo make light of the economic advantages of analog video transmission

Reproduced with permission of copyright owner. Further reproduction prohibited.

which we feel will prevail well into the next decade. The cost of switching cross-points and coding equipment to handle digital video is still prohibitive and when dealing with a PAL signal does not offer notable quality improvements. On the other hand, analog transmission over long hauls served often only by PCM circuits is often impossible. For these reasons the Italtel aproach has been a hybrid one: analog switching and transmission in the local area and the corresponding digital techniques for the wide area.

6.2.2 The Video/Audio Switch

The wideband switch is an analog cross point matrix used to route a PAL video signal and one audio channel associated with it in FDM. This composite 8 Mhz signal is switched in baseband through a cross point with a 3 dB rolloff at 40 Mhz. The manufacturers of cross- point matrices, spurred on by demand from the television industry for an all digital studio using the CCIR 449 standard, are developing a new generation of cross-point switchers that reach circa 70 MHz of bandwidth. These matrices and digital matrices under study for switching PCM signals of 45, 70, and 140 Mb/s will be able to switch, in the near future, analog video signals coded with square wave frequency modulation (SWFM). This technique will permit the signals to be switched in the form in which they arrive at the CO, in SWFM, without the costly modulation and demodulation to baseband. Once broadband digital switches become common in the PCM network, just one type of switch will be needed for both analog video nodes and public digital switching.

For small configurations of up to 40 users a square non-blocking matrix is used. For larger configurations of up to 200 users, a three stage approach is adopted for a savings of up to 70% in the number of crosspoints. The last stage is doubled to allow the insertion of 10 non-blocking broadcast channels. The quality of the crosspoint hybrids is such that multiple passes of the video signal in a three stage configuration will not impair signal quality.

To discover if the economies of using analog video transmission in the local area were real, Italtel conducted two cost analyses for the Rome-Eur project, a local multimedia network initiative sponsored by the operating company SIP: one for an all digital system and one for an analog system with COST-211 codecs only on trunk lines. The all digital system was judged 3.5 times more costly than the analog equivalent mainly due to the use of codecs at every subscriber.

6.2.3 Data Switching

The data switching solution ~~must accomodate two species of datum: user application~~ data and videotelephony signaling data. A packet network solution which would allow the user workstation to mingle signaling and applications data was discarded because of complexity at the user's workstation and lack of a suitable simple packet switch that stopped short of X.25 for the CO. Instead a circuit approach was taken wherein a TDM data PBX at the CO provides circuits of up to 19.2 Kb/s between any 2 users or between the user and the command computer for signaling purposes.

The data PBX provides up to 250 non-blocking TDM slots for asyncronous or synchronous user connections. Circuits are established and brought down with a simple, proprietary user-PBX protocol installed in the resident background task of the user workstations that handles all communications chores. Many PBX voice systems with integrated data services are emerging but there is no guarantee that the customer's existing system will be able to provide the minimum set of data services needed for signaling and applications. In an effort to provide video value added services to any customer, Italtel supplies a data system also. TDM data PBXs are quite inexpensive and in a fully configured system, dip down to $60 a port.

For customers who contemplate buying a new voice PBX system with the LVX, for example, in a virgin office complex, Italtel forsees the embedding of many LVX blocks, such as the command processor and the data PBX, directly into the Italtel SUIP PBX. This leading edge voice/data PBX is based on a multi-processor UNIX architecture for 250 users that, if used in an LVX environment, will provide a much richer set of data services than those described above such as IBM 3270 emulation and ETHERNET interfaces. The SUIP PBX was presented during the SMAU exhibition in Milan last September.

In an ISDN environment, the data PBX will be swapped out and replaced by a packet processor. The packet processor is the unit which currently handles signaling in the D channel and in the future will handle customer packets embedded in the same D channel using frame relaying techniques now under study in Study Group XVIII of the CCITT.

6.2.3 Voice Switching

Voice is normally switched over the public network or over the customer's existing PBX. All videotelephone calls are opened by first establishing a voice only call and only later, if both parties express the desire, does the call proceed into a video phase. Although the user has the capability of transmitting his voice and video associated on the fiber he uses the pre-established telephone channel except for long-distance call. The user has the choice of a handset or 'hands free' operation of the phone.

7. Transmission

7.1 The Local Fiber Loop

Local Fiber Loop - In the first prototype the local subscriber loop is usually fiber but may be coaxial cable with the proper interface at the CO. The fiber is multimodal 62/125 um and carries light generated by LEDs operating in the first window at 830nm. The electrical signal is composed of a baseband PAL signal, an FDM audio signal modulated onto a carrier at 7.8 Mhz, and a 64 Kb/s data signal which is

Reproduced with permission of copyright owner. Further reproduction prohibited.

frequency shift keyed onto a carrier at 9.8 Mhz. This bundle is then modulated in a square wave FM circuit centered around 24 Mhz which in turn excites the LED. At the CO this bundle is demodulated down to baseband ,the data is further demodulated, directed towards the data PBX, and eventually remodulated on the outgoing transmission card of another user. The residual video and associated audio signal are directed to the wideband switch. Laser components can be swapped into the subscriber loop if needs dictate.

In successive versions of the product the switch will pass SWFM signals thus obviating the need to demodulate and remodulate the video at the CO with a windfall of substantial component savings. Figure 3 illustrates the two techniques, present and future, for transmission of multimedia signals. Several methods were examined for tapping off the data prior to the wideband switch without demodulating. A pulse width modulation scheme appeared too thorny to tackle so it was decided to sum the data signal in at baseband after the SWFM video stage; this permits the data to be extracted at the CO with a simple low pass filter.

The central office, in addition to subscribers, will have local service providers for entertainment video, test patterns and the like. These sources may be attached through coaxial cables instead of through costlier optical line cards. The coaxial interfaces must mix audio and video in the same manner as the optical line cards to achieve system wide homogeneity.

7.2 Public Network Access

For gateway connections between LVXs, the compressed video is transmitted over the RFD or switched 64 Kb/s data network. The line termination units are controlled by the command processor and its FEP and are syncronous X.21 channels. 2 Mbit/s leased lines are foreseen also and the interface will be G.703. As leased 2 Mbit/s circuits become widespread, Italtel DCSs (Digital Crossconnect Systems) will be deployed to make add drop multiplexing more manageable.

8. Video Coding

8.1 Overview

The scarsity and high cost of circuits at 2 Mbit/s and greater and the advent of ISDN have made 64Kb/s circuits the most practicable channel for desk to desk video communication. Unfortunately there is no international consensus on coding techniques and a glance at the proceedings of the CCITT Study Group XIII reveals that none can be expected until after 1992. Italtel has adopted a proprietary coding scheme for trunk lines which renders interworking with the few existing 64 KB/s codec systems next to impossible but services can be tested nevertheless and the coding schemes can be made to adapt to the new standards when finalized.

8.2 Codec Characteristics

The codecs reduce the PAL video to a bit rate of between 48 and 224 Kb/s by using motion coding transforms, spatial, and temporal subsampling; they are auto-baud and adapt automatically to the line rate. The digital signal processing is so laborious that a 500msec delay is experienced between the input and output of the device which, already annoying in itself, would create insurmountable lip syncronization problems were the audio not encoded in the same codec and subjected to the same delay. A user data channel is also implemented which gives the user the possibility to create a bit stream of video, audio, and data in a unique signal of 56-224 Kb/s. This stream can be further split in two and recombined at the remote end to permit the use of 2 lower bit rate circuits. In the Italtel LVX configuration, 2 64 Kb/s lines are used to create a mix of 96 kb/s video, 32 kb/s audio, and a low bit rate user data stream.

8.2 Codecs in the Public Network

When codecs are employed as gateways to other LVXs, the voice signal must be switched from the public network and routed through the wideband switch together with the video to maintain lip-synch. The delays experienced in the codec create serious echo problems at the audio input and output of the codec where the codec's four wire connection meets the public network's or PBX's two wire connection. To avoid the use of echo cancellors, the workstation's telephone commutes automatically from a two wire to a four wire connection the instant a long distance video call is established.

8.3 Videocoding Prospectives

A second generation of 64 Kb/s videocodecs is already in development that will halve the size, consumption, and price of those on the market. A 64 Kb/s codec that fits on one IBM-PC board has been produced, and while the quality of it was judged unacceptable for our application, it is a favourable portent that these codecs will, with successive VLSI reductions and the economies of scale that a world-wide standard will offer, may one day be integrated directly into the user workstation. The dual 64 Kb/s channels used in the LVX are suitable to the ISDN environment as well. Larger systems could have 64 Kb/s and 2 Mb/s codecs and offer different grades of service depending on the transmission cost.

9. The User Workstation

The user workstation consists of a microcomputer with a central processor board running MS-DOS and a peripheral communication board with a modem, a serial port, telephone interface, and videotex firmware. A serial port on the mother board interfaces to the user's fiber optic modem for data transmission to the CO. Figure 4 shows a block diagram of the workstation, christened 'Computel', and an accompanying drawing of the industrial design.

It was decided that the only acceptable operating system that would satisfy the user's local processing requirements was

Reproduced with permission of copyright owner. Further reproduction prohibited.

MS-DOS, a single user system, but this posed the problem of how to allow the user to stay minimally informed about the state of the network and to make videotelephone calls independently of his local applications such as wordprocessing. The solution was to modify MS-DOS cleverly enough to permit a resident background network task to run but not to interfere with canned MS-DOS programs. This was effected by creating a periodic non-maskable interrupt to the CPU which affords it the opportunity to do housekeeping chores and check the network for messages, all this unbeknown to the operator.

The modular user station has a high resolution screen and can be mounted with an optional RF television tuner so that a single screen serves for EDP, videotelephony, and entertainment television. The station is supplemented with a hidden video camera centered above the screen behind smoked glass and, as an accessory , another TV camera can be attached to a copy stand for graphics transmission. Since video calls can take place independently of local applications, requests for video calls will be communicated to the user either through screen windowing or momentary screen blanking.

10. Videotelephony Signaling

Signaling in the LVX is a combination of public telephone signaling and proprietary videotelephone signaling. All video calls begin with a POTS telephone call between two local users or a local and remote user. The call will remain merely a POTS call until the subscribers decide to pass to the video stage.

At this point a series of information must be exchanged between the subscribers and their COs which will lead to a crosspoint closure and, if the call is to another cluster, to an attempt to bring up a pair 64Kb/s lines. The most critical information the CO must have is the telephone number and LVX port of the interlocuter to which his subscriber is attached. Since the LVX is not connected to the telephone system or local voice PBX (it would be too demanding to ask the LVX to attach to different brands of PBX) it does not have this information. This lack of information is complicated by possible internal transfers from the orignal number dialed before the final distination is reached.

This hurdle is overcome by switching data modems in parallel with the voice channel at the two end terminals. When the users, after a verbal agreement, press the function keys to give their consent for a video call, the modems are inserted in-line and transmit an in-band data stream in which each station transmits it's absolute address to the other. At the end of the dialogue each station knows all the information about his interlocuter necessary to permit his CO to control the wideband matrix and/or dial-up lines for the call without the CO ever having to interrogate the voice PBX or monitor in any way the public network.

11. Conclusion and Evolution

Almost all the elements that go into making the LVX are in a technological state of flux and will have to adapt to emerging technologies quickly. There are three principle scenarios for use of the system in the next 5 years: the value-added service market for existing equipment, the ISDN market and the wideband ISDN market. Table 2 shows probable evolution of the current LVX taking into account trends in technology and service already evident.

The thrust of the first prototype is to test services by trying to awaken an embrionic market for a product that has never been properly tested. Video communication experiments up until now have always been fettered by factors such as the necessity of high speed transmission equipment and expensive codecs, conference centers that were difficult to reach, and regulated public networks that prevented service providers from having free rein in testing new services. The services and the switching technologies will grow to fill the wider bandwidths offered by the bearer service and both these factors are very much in play in the LVX.

The LVX lends itself to both the private and public domains; in the first as a value added service for a private PBX, and in the second as a value added service for privileged groups under the operating companies' management such as Centrex users and customers who desire videoconferancing services but cannot make the heavy capital investments for a private center. We hope that the LVX, which will provide low cost desk-to-desk service will be one of the first to improve the checkered reputation of video communication services.

REFERENCES

[1] RACE Doc. PN-GSLB Project 1006, 1033, RACE Definition phase Scenario 1 (RDPS-1), pp. 12-24, May 28, 1986.

[2] P. Klein, "Desktop Tele-conferencing," Siemans Telecom Report, Vol. 10, 1987, No. 1, pp. 2-6.

[3] CCITT SG XVIII, Reports of BBTG TD 21,16, Hamburg, July 1987

[4] Bigi, Giorgetti, Debosio, "Isola Ottica Della Fiera Di Milano," Elettronica e Telecom., No. 6, pp. 251-261, 1985.

[5] D.Vlack, H.R. Lehman, "An Exper-imental Video Switch Architecture," prodeedings ISS Florence, session 24, May 1984.

[6] K. Sato, S. Aoyagai, T. Kitami, "Fiber Optic Video Transmission Employing Square Wave Frequency Modulation," IEEE Trans.Comm., vol.com-33, no.5, pp. 417-424, May 1885.

Reproduced with permission of copyright owner. Further reproduction prohibited.

LVX Block Diagram

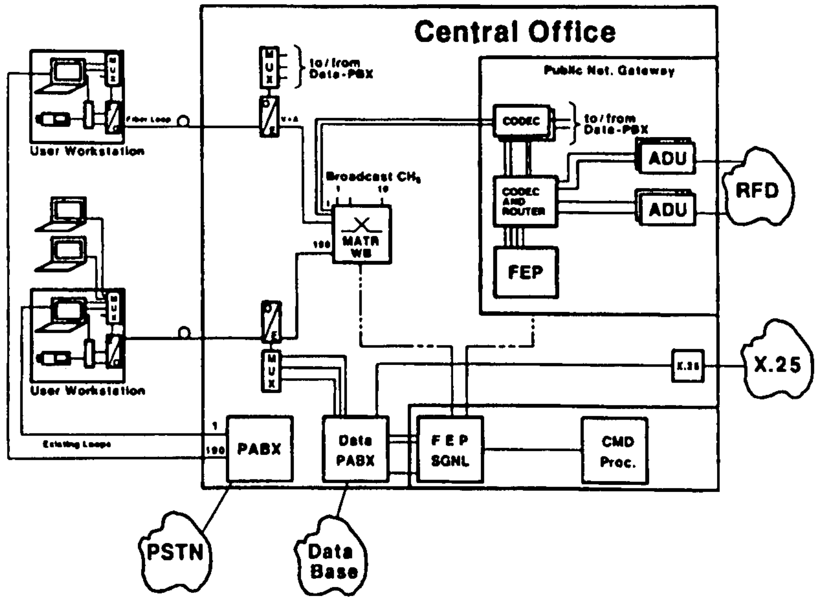
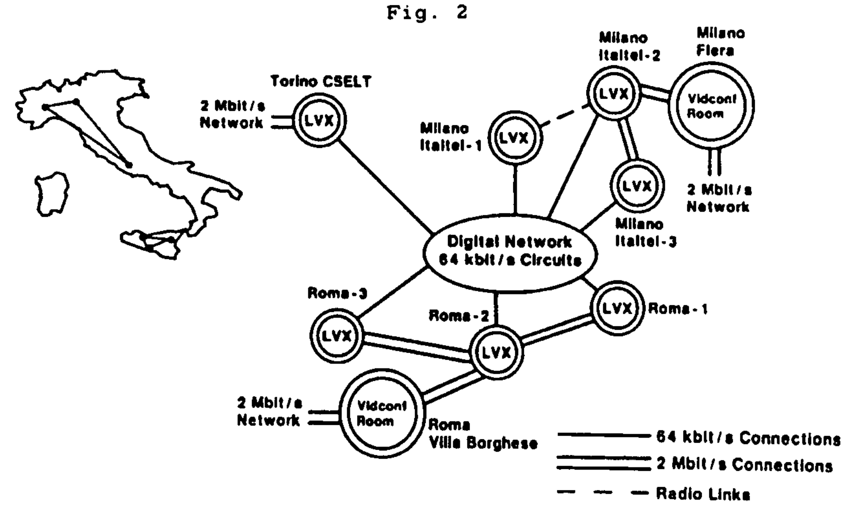
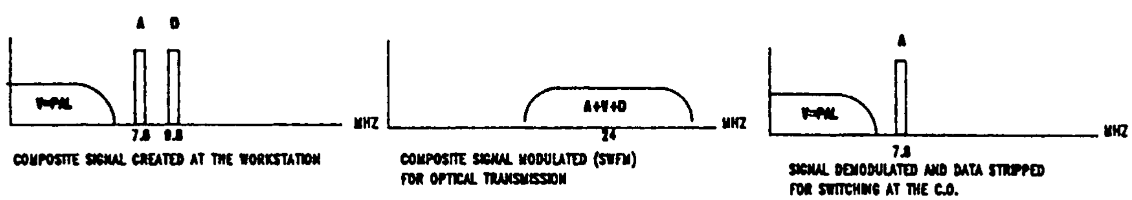


Fig. 1

Proposed LVX National Network

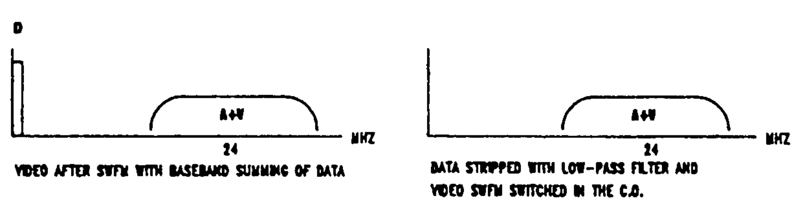
Fig. 2





CURRENT PROTOTYPE TRANSMISSION SCHEME

Fig. 3



SECOND GENERATION TRANSMISSION SCHEME

Reproduced with permission of copyright owner. Further reproduction prohibited.

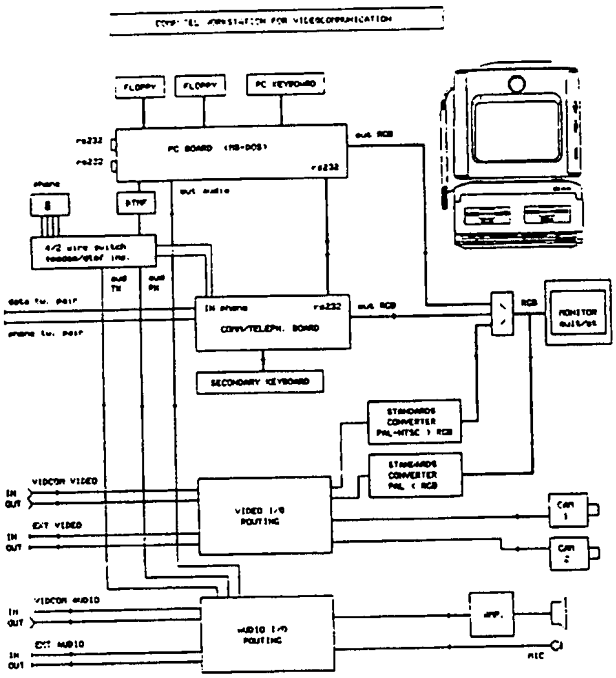


Fig.4

	LAN	WAN	DAT	LVX
Business Services:				
Video Messaging	x	x	x	
Interactive Training	x	x	x	x
Taped Training	x			x
Image Retrieval	x	x		x
Multipoint Videoconferencing				
* Switched Single Image	x	x	x	
* Concurrent Multiple Images	x	x	x	
Desk-Desk/Group-Group Videotelephony				
* High Quality	x		x	x
* Low Quality		x	x	x
Local-Source Broadcasting	x			x
Surveillance/Security	x		x	x
Public/Entertainment Services:				
Home Shopping		x	x	
Banking		x	x	
Lending Library		x	x	
Broadband Videotex		x	x	
High Quality Entertainment TV		x		
Residential Videotelephony		x		
FM/CATV Reception in W.S.		x		x

LAN = Terminations are likely to be in the same campus area
WAN = Terminations are likely to be geographicaly distant
DAT = Service is supplemented by concurrent datacom.
LVX = Implemented in the first generation LVX

VIDEOMATIC SERVICES

Table 1

FUNCTION	CURRENT IMPL. 1988	INTEGRATED PBX 1990	ISDN, BB-ISDN 1996
VIDEO SWITCH	10MHZ ANALOG	60 MHZ SWFM	70/140 MBIT/S DIGITAL
VOICE SWITCH	EXISTING PBX	SUIP DIGITAL PBX	ISDN PBX/PUBLIC NETWORK
DATA SWITCH	DATA TDM PBX	ETHERNET IN SUIP BACKPLANE	ISDN PACKET PROCESSOR OR PACKET RELAYER
WORKSTATION	MS-DOS PC	MULTITASKING PC	ISDN WORKSTATION WITH MULTITASKING O.S.
COMMAND PROCESSOR	PHP MINICOMPUTER	SUIP UNIX PROCESSOR	ISDN PACKET PROCESSOR
NETWORK FEP	MICROCOMP.	SUIP GATEWAY BOARDS	DCS INTERFACE FOR NEW SYNCH. HIERARCHY
SUBSCRIBER LOOP	OPTICAL FIBER LED/1st WINDOW SWFM	OPTICAL FIBER LED/1st WINDOW SWFM	OPTICAL FIBER LED/LD TDM-NEW SYNCH. HIERARCHY
PUBLIC NET. GATEWAYS	64 KB/S 'RFD'	64 KB/S ISDN 2 MB/S SEMIPERM. CIRCUITS	NEW SYNCH. HIERARCHY 2 MB/S - 153 MB/S

Table 2 EVOLUTION OF THE LVX

Reproduced with permission of copyright owner. Further reproduction prohibited.

Best Available Copy
091072,549

5. There are differences in the techniques for color-subcarrier encoding represented by NTSC, PAL, and SECAM, and in each case there are many differences in the details of various synchronization pulse widths, timing, and tolerance standards. It is evident that one must refer to the CCIR documents for complete information on the details of the combined monochrome/color standards. A summary of these signal generation and transmission standards is given in Secs. 21.3 and 21.4. Figure 21-2 presents a comparison, approximately to scale in the baseband domain, of the relative bandwidths, color-subcarrier frequencies, and sound-carrier relative spacing for the major color systems used in the world today.

Table 21-6 shows channel assignments in the United States to the principal communities, territories, and possessions. Channels designated by a superscript letter *b* are

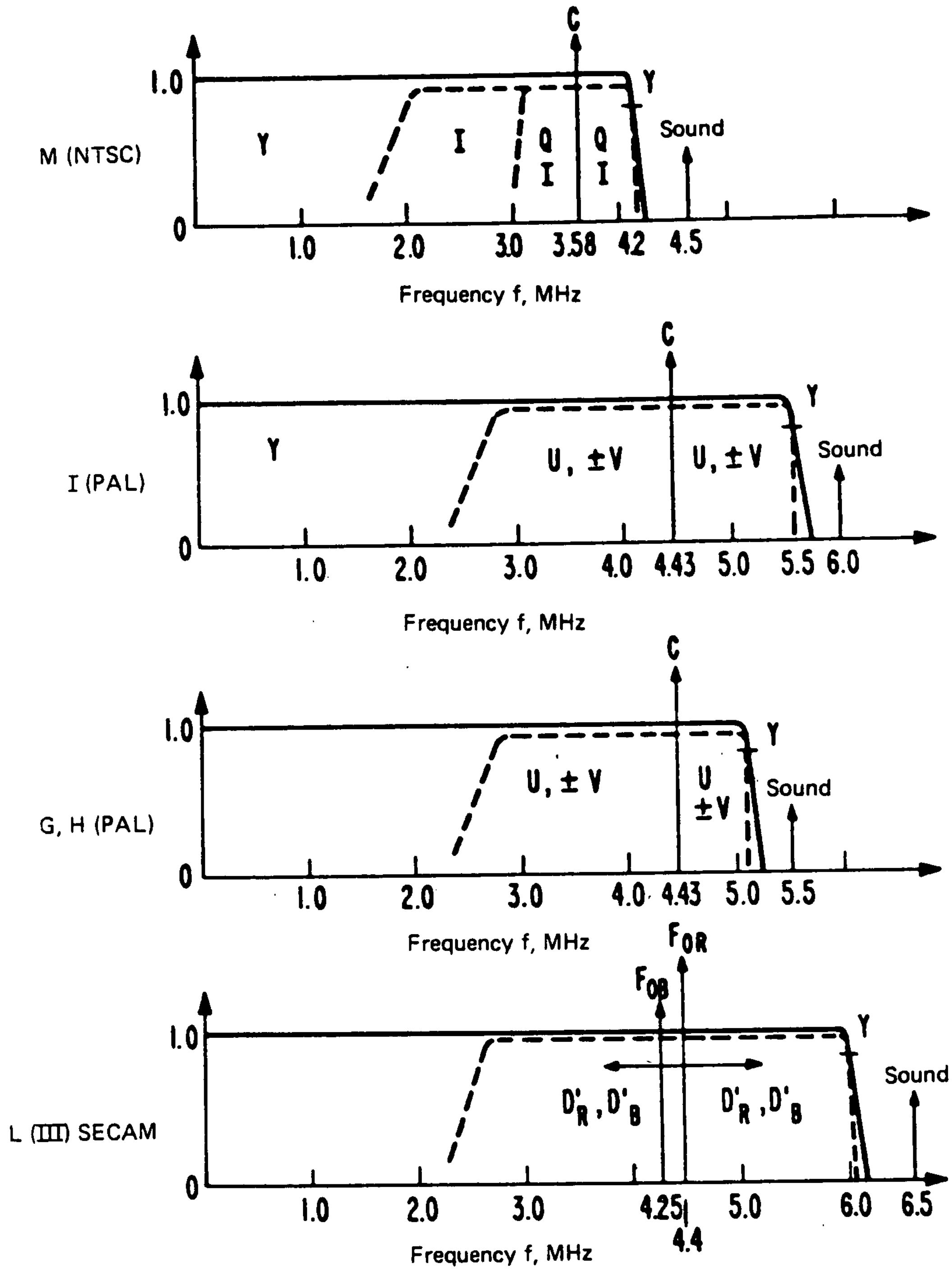


FIG. 21-2 Bandwidth comparison among NTSC, PAL, and SECAM.

Table 2
L
AL Anda
AK Anch
AK Fairb
AK Ketc
AZ Flags
AR Little
CA Los A
CA San I
CO Denv
FL Dayt
FL Mian
GA Atlar
HI Hilo
HI Hono
ID Boise
IL Chica
IN Terre
IA Cedar
KS Grea
LA Bato
ME Ban
MD Balt
MA Bost
MI Detr
MN Min Paul
MS Miss
MO St.
MO St. L
MT Ana
MT Billi
NE Nort
NV Gold
NV Ren
NM San
NY Buff
NY New
NY Uti
NC Co
NC Gre
ND Dick
ND Gra
OH Day
OK Tuls
OR Klar
OR Port
PA Pitts
SC Char
SD Sene
SD Vern
TN Nash
TN Snee
TX Ama
TX Den